High Performance Green Schools

What is the Hazard or Problem:

Stakeholders involved in new school construction and major school renovation projects in Massachusetts are not considering the benefits of high performance green design as part of the design phase decision-making process.

The Solution:

Stakeholders should develop an understanding of how the physical environment (i.e., the school building itself) can play a role in improving student and teacher health and productivity and can save money while minimizing impact on the environment. High performance green schools are energy efficient, water efficient, have improved indoor air quality, maximize the use of natural light, and use renewable technologies.

Applicable Regulations/Consensus Standards:

The Massachusetts Technology Collaborative (MTC – a quasi state agency) and the Massachusetts Department of Education have teamed up for a pilot program called the Green Schools Initiative, which is providing school districts in Massachusetts with the information and resources necessary to help them design and build high performance green schools that are energy efficient and that use renewable energy technologies.

MTC has awarded 40 feasibility study grants to school districts across the state and, with its partner the Massachusetts Department of Education, has selected 17 pilot projects from a competitive pool of applicants to receive grants that will assist them in designing and constructing green schools. Data collected from the 17 pilot projects will be used to prepare detailed case studies that will inform the process of developing new standards to encourage high performance green renovation and new construction projects in the future.

A draft version of Massachusetts Green Design Standards, also known as MASS-CHPS (Collaborative for High Performance Schools) is an excellent reference for school building committees and their service providers, such as architects and engineers. It provides the guidance and information needed during the school design and construction process to achieve a high performance school. See the MTC website to download free copies of MASS-CHPS, volumes I and II.

Website: www.mtpc.org/RenewableEnergy/green_schools/chps_standards.htm

Who in your Town or School Can Help:

School Committee or School Building Committee members
Superintendent of Schools
Facilities Manager
School Business Manager
Other school administrators
Interested citizens

Who to contact for free Government or Other Assistance with the Problem:

In Massachusetts, contact the Massachusetts Technology Collaborative, Green Schools Initiative Manager at (508) 870-0312, or the Green Schools Program Coordinator at the MA Department of Education at (781) 338-6531.

Further Reading (include Electronic Resources if Applicable):

This is not an exhaustive list, but, nonetheless, offers a good place to start.

Resource Directory for High Performance School Design and Construction

U.S Government Resources

USDOE/Energy Smart Schools site

http://www.eren.doe.gov/energysmartschools/index.html

This program outlines four primary goals: (1) Reducing energy consumption and costs, and increasing use of clean energy technologies in K-12 schools nationwide; (2) Helping schools reinvest their savings from energy improvements; (3) Improving the learning environment of schools through daylighting, better temperature control, better air quality and other elements related to buildings and bus fleets; and (4) Increasing student, teacher, and community awareness of energy and related issues including financial management, air quality, climate change, and new technologies

Rebuild America News on Schools

http://www.eren.doe.gov/energysmartschools/news_schools.html

This site includes short updates about what schools around the country are doing to save energy.

EREN Buildings link

http://www.eren.doe.gov/EE/buildings.html

This is the main buildings site link for the U.S Department of Energy's Office of Energy Efficiency and Renewable Energy.

Energy Star on-line technical seminars

http://www.ecadmus.com/ecadmus/forums/ESInternet/Default.htm

Energy Star offers various online technical seminars relating to building design, construction implementation, benchmarking, and financing.

EPA Indoor Air Quality in Schools

http://www.epa.gov/iag/schools/index.html

IAQ Tools for Schools is a nationwide initiative to help school officials assess, resolve, and prevent indoor air quality problems and reduce exposure to asthma triggers in school facilities.

National Clearinghouse for Educational Facilities

http://www.edfacilities.org

Created in 1997 by the U.S. Department of Education, the National Clearinghouse for Educational Facilities (NCEF) is a free public service that disseminates information about K-12 school planning, design, financing, construction, operations and maintenance.

Non-Profit Resources

Consortium for Energy Efficiency - Schools

http://www.cee1.org/com/bldgs/schools.php3

The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.

Alliance to Save Energy - Greenschools

www.ase.org/greenschools/newconstruction.htm

http://www.ase.org/programs/schools.htm

The Alliance to Save Energy is a nonprofit coalition of prominent business, government, environmental, and consumer leaders who promote the efficient and clean use of energy worldwide to benefit the environment, the economy, and national security.

Energy Services Coalition - Energy Performance Contracting

http://www.escperform.org

The Energy Services Coalition is a national nonprofit organization composed of a network of experts from a wide range of organizations working together at the state and local level to increase energy efficiency and building upgrades through energy savings performance contracting. Energy savings performance contracting enables building owners to use future energy savings to pay for up-front costs of energy-saving projects, eliminating the need to dip into capital budgets.

SBIC Home Page

http://www.sbicouncil.org/home/index.html

The Sustainable Buildings Industry Council (SBIC) is an independent, nonprofit organization whose mission is to advance the design, affordability, energy performance, and environmental soundness of America's buildings. SBIC serves as a national resource clearinghouse for whole building design, product information, professional training, consumer education, and analytic tools.

State-Specific Resources

MTC (Massachusetts Technology Collaborative)

http://www.masstech.org

MTC's Green Schools Initiative goal is to provide school districts in the Commonwealth of Massachusetts with the information and resources necessary to enable the incorporation of renewable energy technologies, environmental quality, and efficient resource use into the planning, design and construction of school building projects.

Massachusetts Healthy Schools

http://www.mphaweb.org/pol_schools.html

The Massachusetts Healthy Schools website is a resource for promoting healthy indoor air environments and environmentally sustainable school buildings in Massachusetts. It contains information on: building green schools, developing health and safety plans for schools, avoiding toxins, learning about state laws and regulations, and available health and safety grants.

California High Performance Schools

http://www.chps.net

The California High Performance School Collaborative's goal is to facilitate the design of high performance schools: environments that are not only energy efficient, but also healthy, comfortable, well lit and contain the amenities needed for a quality education.

Building Benchmarking Resources

Massachusetts Green Design Standards

www.mtpc.org/RenewableEnergy/green schools/chps standards.htm
The Massachusetts Technology Collaborative is developing green design standards for Commonwealth K-12 schools. Participants in the Green Schools Initiative have successfully designed their schools according to the Massachusetts Green Design Standards. The latest version is available at the website mentioned above.

U.S. Green Building Council's LEED Rating System

http://www.usgbc.org/

The U.S. Green Building Council is a coalition of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable, and healthy places to live and work.

Energy Star for Schools

http://yosemite1.epa.gov/estar/business.nsf/webmenus/Schools

Interactive tools, software, and calculators to measure the energy and financial performance of a building.

What is a High Performance School?¹

"High Performance School" refers to the physical facility. Good teachers and motivated students can overcome inadequate facilities and perform at a high level almost anywhere, but a well-designed facility can truly enhance performance and make education a more enjoyable and rewarding experience. The



following features define a high performance school.

A high performance school is healthy. High indoor environmental quality is essential. The significant amount of time that students and teachers spend inside schools during the course of their educational career, combined with children's increased susceptibility to indoor pollutants underlines the importance of healthy schools.

A high performance school is thermally, visually, and acoustically comfortable. Comfort includes thermal comfort, visual comfort and acoustic comfort. Thermal comfort means that teachers, students and administrators should neither be hot or cold as they teach and learn. Visual comfort means that quality lighting makes visual tasks, such as reading and following classroom presentations, easier. The lighting for each room is "designed," not simply specified. Daylight and electric light are integrated, and glare is eliminated. Visual comfort also means providing a connection to the out-of-doors and visual stimulation through the use of eye level windows. Acoustic comfort means teachers and students can hear one another. Loud ventilation systems are eliminated, and the school minimizes outdoor and indoor noise from reaching the classroom.

A high performance school is energy efficient. Energy efficient schools save money while conserving non-renewable energy resources and reducing atmospheric emissions. A high performance heating/ventilating/air conditioning (HVAC) system uses high efficiency equipment; is "right sized" for the estimated demands of the facility; and includes controls that boost system performance. The school's lighting system: uses high efficiency lamps and ballasts; optimizes the number of light fixtures in each room; incorporates controls that ensure peak system performance; and successfully integrates electric lighting and daylighting strategies. The walls, floors, roofs and windows of the school are as energy efficient as cost effectively possible. The building shell integrates and optimizes: insulation levels, glazing, shading, thermal mass, air leakage and light-colored exterior surfaces.

A high performance school is material efficient. To the maximum extent possible the school incorporates materials and products that are durable, non-toxic, derived from sustainable yield processes, high in recycled content and easily recycled themselves.

A high performance school is water efficient. High performance schools are designed to use water efficiently, saving money whiled reducing the depletion of aquifers and river systems. The school uses as little off-site water as possible to meet its needs, controls and reduces water run-off from its site, consumes fresh water as efficiently as possible, and recovers and reuses graywater to the extent feasible.

¹ From "CHPS Overview," The Collaborative for High Performance Schools, http://www.chps.net/overview/overviewWhatIs.htm

A high performance school is easy to maintain and operate. Building systems are simple and easy to use. Teachers have control over the temperature and lighting in their classrooms, and are trained how to most effectively use them.

A high performance school is commissioned. The school operates the way it was designed to and meets the needs of the owner. This is made possible by implementing a formal commissioning process - a form of "systems check" for the facility. The process tests, verifies and fine-tunes the performance of key building systems so that they perform at the highest levels of efficiency.

A high performance school has an environmentally responsive site. To the extent possible, the school's site: conserves existing natural areas and restores damaged ones; minimizes stormwater runoff and controls erosion; and enhances the school building's high performance features.

A high performance school is a building that teaches. By incorporating important concepts such as energy, water, and material efficiency, schools can become tools to illustrate a wide spectrum of scientific, mathematic, and social issues. Mechanical and lighting equipment and controls can be used to illustrate lessons on energy use and conservation, and daylighting systems can help students understand the daily and yearly movements of the sun.

A high performance school is safe and secure. Students and teachers feel safe anywhere in the building or on the grounds. A secure environment is created primarily by design: opportunities for natural surveillance are optimized; a sense of territoriality is reinforced; and access is controlled. Security technology is used to enhance, rather than substitute for, the design features. High performance does not compromise safety.

A high performance school is a community resource. The most successful schools have a high level of parent and community involvement. This involvement can be enhanced if schools are designed to be used for neighborhood meetings and other community functions.

A high performance school is stimulating architecture. High performance schools should invoke a sense of pride and be considered a genuine asset for the community.

A high performance school is adaptable to changing needs. High performance schools need to be able to embrace new technologies and respond to demographic and social changes.

Creating a school with these characteristics is not difficult, but it does require an integrated, "whole building" approach to the design process. Key systems and technologies must be considered together, from the beginning of the design process, and optimized based on their combined impact on the comfort and productivity of students and teachers. At the end of the process the entire facility will be optimized in terms of long-term performance. The result will be a finished school that is an enduring asset to its community; one that enhances teaching and learning, reduces operating costs, and protects the environment.

Massachusetts Green Schools Initiative Kim Cullinane Manager, Green Schools Initiative, Massachusets Technology Collaborative MA Department of Education

What is a High-Performance Green School? One that integrates High performance design features Energy efficiency measures Renewable energy technologies

What is a High-Performance Green School? Green School? Green Concepts integrated from the very beginning. Not just add-ons Considers the "big picture" - lifecycle cost analysis (LCCA). More comfortable, more productive, healthier environment. A building that teaches

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What Are the Benefits?

Safer for the environment

- Has reduced impact on the environment.
- Is energy and water efficient.
- Uses durable, nontoxic materials that are high in recycled content and are themselves easily recycled.
- Preserves pristine natural areas on their sites and restores damaged ones.
- Uses nonpolluting, renewable energy to the greatest extent possible.

What Are the Benefits?

Improved learning/working environment

- Increased average daily attendance of employees/students
- Increased employee/teacher satisfaction and retention
- Improved student/employee performance



What Are the Benefits?

Saves money

- Cost-effective energy performance improvements can reduce energy bills by 25 to 30 % on average
- Built to be durable, so requires less maintenance
- Better indoor air quality, healthier environment - reduced liability exposure from sick buildings

Green Schools Initiative – A Partnership Between MTC and the M

A Partnership Between MTC and the Mass. Dept. of Education

- Provides school districts in the Commonwealth with the information and resources necessary to build schools that integrate:
 - ◆ Energy efficiency
 - High performance design
 - Renewable energy technologies



Natural light from a skylight penetrates

Green Schools Initiative - Goals

- Stimulate increased construction of green schools and use of renewables
- Increase knowledge of green schools and renewables among:
 - Building professionals
 - General public
- 17 design/ construction grants
- 40 feasibility study grants
- Total of 86 municipalities reached
- Case Studies
- Market transformation



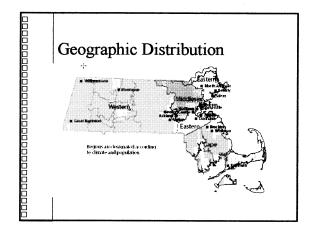
Solar panel installation at the Centervill Elementary School in Beverly

Why Schools?

- Schools touch many people
 - ◆ EPA says each day 1 in 5 Americans occupies a school building
- Schools are often community meeting places great opportunity for community learning
- Visible public replicable projects
- Average age of schools is 42 years (in MASS?)

Green Schools Initiative - Other **Key Elements** ■ Some commissioning required ■ Energy modeling required to show that school will beat MA energy code by 20% ■ Use of MASS-CHPS ■ Participate in available utility rebate programs ■ Case studies Future of Green Schools Program ■ Mass Green Design Standards finalized ■ Program shifts from MTC to Dept. of Education ■ Minimum high performance design criteria to be implemented for all schools ■ Incentive program likely to be continued; funding tied to level of "green" ■ Continued emphasis on buildings that teach The Pilot Projects Distribution of school types: ■ 11 new schools

6 addition/renovation schools
 2 schools from municipal light & power districts
 Mixture of elementary, middle, high, and vocational schools



Outputs and Outcomes

Projected Installed Renewable Capacity

■ PV 490 KW

■ Wind 23 KW

■ Fuel Cells 200 KW

■ Total = 713 KW

*On average, schools are projected to beat the energy code by

34% based on modeling data.

MATCH school Powerlight PV installation costs = \$12,782/kW Capuano Powerlight PV installation costs = \$9,119/kW Cost reduction of about 29% from one installation to the next.

Projected kwh and \$ Savings

	Average Per Project	For All 17 D&C Projects	For All 48 Schools	
kwh gen./ yr from renewables	48,000 kwh/year	816,000 kwh/year	n/a	
Overall kwh savings/year Efficiency + Renewables	ear kwh/year kwh/year		23 million kwh/year (assumes 480,000 kwh/year/project b/c not all will install renewables)	
S savings/ year	\$68,000/year	\$1,156,000/year	Over \$3 million	
Utility rebates	\$108,000	\$1,836,000	\$5,184,000	

High Performance Design

Indoor Air Quality

- Plan for minimizing dust on site during construction
 Protection of HVAC equipment prior to installation
 Building flush out prior to occupancy
 Cocupancy sensors-connected to ventilation system
 Cocupancy

- CO₂ sensors
- Low or no VOC paints, sealants, mastics, and carpeting
 Operable windows



High Performance Design

Water Conservation

- Soil moisture sensors and drip irrigation (expected to reduce irrigation water usage by 56% in one project)
- Storm water management underground infiltration
- Native plantings with low water requirements
- Rainwater harvesting and reuse
- Low flow fixtures
- Waterless urinals
- Metered faucets



High Performance

- Energy Efficiency

 Building orientation on site
 Improved building envelope improved insulation, sealing of
 penetrations

 Dirrect digital control systems

 High efficiency boilers

 Downsizing of HVAC components

 Demand vertilation

 High efficiency pumps/fans

 Cool roofs

 Use of shade trees

 Energy Star rated appliances



Energy Modeling

- Comprehensive energy modeling instrumental for making design decisions
 The energy analyst can suggest design modifications that the design team may not know about
 Prepares project owners to seek utility energy efficiency funds
 Pennises and understudien by

- Requires good understanding by client of how and when building
- Requires integral involvement of architect and engineer



Williamstown Elementary School

Building Commissioning

The Facts:

- Ensures complex delivery systems meet their design goals
- Reduces numbers of change orders
- Prevents call backs after school is occupied
- Pays for itself in 1 to 5 years
- Costs roughly between 1%-2% of the total design and construction costs or 2%-4% of the cost of the systems being commissioned
- Basic commissioning required by MASS-CHPS

What You Can Do NOW!

- FREE electricity audits with state contractors!
- Optimize lighting systems
- HVAC system maintenance change filters, ensure air intakes and exhausts are clean and clear, system balancing
- Purchase non-toxic cleaners from State Environmentally Preferred Products program (EPP)
- Clean and dry water damaged areas within 24 hours
- Maintain clean walk-off mats
- Inventory chemicals used for cleaning, art, and chemistry labs, contact local bureau of health or fire department for disposal information
- Prevent idling of diesel buses on or near school grounds

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	GO TO:			
	Massachusetts Technology Collaborative website:		· · · · · · · · · · · · · · · · · · ·	
	www.mtpc.org/RenewableEnergy/Green_Schools.htm			
	OR			
	the Healthy Schools website:			
	http://www.mphaweb.org/pol_schools_resources.html			
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